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Reclaimed and Reused

While curbside recycling of household refuse has gotten the most attention, the materials discarded at construction sites open up a new world of recycling possibilities. Public and private contractors are stepping into that void and finding ways to give old materials new purpose.

Construction and demolition materials resurface when recycling is in the blueprint

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When Houston's George Bush Intercontinental Airport unveiled a renovated runway in 2002, civic and aviation leaders gathered to dedicate the project, which represented 300,000 cubic yards of pavement. As the ribbon-cutting festivities took place atop the polished surface, most celebrants probably didn't realize that the \$81.5 million project was not entirely new.

In fact, much of the old runway is still present--in a different form. Rather than demolish the old runway and carry the debris to a landfill, crews ground up the pavement, made new aggregate, and used the recycled blend in both the base and top layers of the runway, which was lengthened from 6,000 to 10,000 feet. Money was saved by reusing materials and doing reclamation on the job site.

The following year, the same strategy was applied to construction of a 9,000-foot-long runway. Again, recycling trimmed costs. According to construction officials, building both projects with recycled--rather than virgin--materials recouped \$300,000. But the bulk of savings--\$2 million--came by avoiding the costly removal of 200,000 tons of demolished concrete to landfills and the associated disposal fees.

The airport projects are examples of a trend in which recovered construction and demolition materials are incorporated into new projects, thereby saving money and reducing demands on natural resources and landfills.

State government has helped fuel the recycling movement. Last year, the Texas Department of Transportation (TxDOT) spent about \$677 million on recycled materials--purchases that ranged from fly ash to crushed concrete and recycled steel. Doing so diverted 2.5 million tons of refuse from landfills across the state. The crushed concrete alone saved the agency more than \$1.2 million.

Private industry also sees advantages in reusing materials. Manufacturers, power generators, and demolition companies search for opportunities to reuse their byproducts and salvaged materials to reduce disposal costs. Also, putting these materials to use saves on hauling costs, particularly when new materials would have to be transported from long distances. Air quality benefits, too, because diesel trucks make fewer trips.

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Sparing Landfills

The growth of recycling in the U.S. construction industry "has been explosive" the last 15 years, says William Turley, head of the Illinois-based Construction Materials Recycling Association.

European countries pioneered the movement. In the aftermath of World War II, crude forms of aggregate crushers were used to recycle rubble from buildings and roads ruined by bombs. But the real credit, Turley insists, should go to the Romans--renowned road builders who established the practice of reusing stones from older roadways.

Today, waste from construction and demolition represents about one-fourth of the waste stream in North America,



Turley said.

TCEQ records show a total of 6.4 million tons of this kind of waste, or 22 percent of the contents disposed of in Texas landfills in 2002.



Sleek, modern safety rest areas like this new one on Interstate 40, east of Amarillo, offer ample opportunities for using recycled materials. These state projects often incorporate elements such as fly ash and recycled steel in the buildings, and crumb rubber from scrap tires in the playground./ Photo by the Texas Department of Transportation

"The importance of recycling construction waste and demolition debris is recognized more and more because it conserves many of the world's resources, such as wood, stone, and petroleum," said Turley. "Also, construction activity generates millions of tons of materials every day from building roads, bridges, and houses. It's much more than the household waste stream of tin cans, plastics, and newspapers.

"Just think about a single hail storm inundating a community. When homeowners get new roofs, what happens to all those discarded asphalt shingles?"

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Regional Differences

The answer to where shingles and other building materials end up depends on geography. In areas like Texas—where tipping fees at most landfills are relatively cheap, compared to more densely populated areas of the

country—shingles and other materials are often disposed of in landfills. But in some older, urban areas, there is pressure on private industry and local governments to reprocess the waste. The state of Massachusetts is studying the option of banning construction materials and debris from landfills.

In Texas, recycling practices vary by region, usually as a consequence of economics. Recycling occurs most often when it generates a savings.

Houston, for example, has little natural aggregate—the crushed stone, sand, and gravel essential to making concrete. For decades, local contractors paid high costs to have mountains of aggregate trucked in from Central Texas or barged in from the Yucatan region of Mexico.

"In the early 1990s, the idea of using crushed concrete really started coming together in this area," said Mark Briggs of HPP Corp. in Houston. The former consultant participated in early TxDOT studies on materials with the potential for reuse. "We found that, by far, recycled base materials held the most promise. In the past, these materials had been abandoned or disposed of in landfills, but all of a sudden we were talking about millions of tons that could be reused, put back into building projects."

TxDOT conducted rounds of performance tests until the agency was satisfied that recycled concrete would not compromise the structural integrity of newly built projects. Then, construction and maintenance specifications were revamped to eliminate the requirement for all-new materials. The TCEQ helped by approving regulations to promote recycling and, as a member of the Texas Recycling Market Development Board, encouraged state agencies and local governments to purchase recycled materials and recycled-content products.

Still, there was the matter of educating the construction industry "because people weren't used to buying recycled base materials," Briggs recalled. "When companies learned they could purchase material of comparable quality for less money than the native materials, economics became the driver."

He noted that crushed concrete has not found a market in areas such as Central Texas and San Antonio, where natural aggregate such as limestone is plentiful. Houston was a ready market because the region lacked the natural resource.

In Fort Worth, one of the city's largest recycling projects is under way, as RadioShack builds a new corporate headquarters downtown. Construction began last year on three six-story buildings.

"We have big containers out there designated for trash and for recycling," explained John Vick of IESI, the waste services company hired to handle debris. "Everything is color coded, so that Sheetrock goes into one container;

Recycled Roadways

In fiscal 2003, the Texas Department of Transportation spent almost \$677 million on recycled-content products to build and repair roadways. Those purchases represented 2.5 million tons of materials put to beneficial use. In addition, the agency reclaimed more than 1.2 million cubic yards of asphalt paving, and committed to buying 433,000 cubic yards of compost for establishing vegetation and controlling erosion.

Recycled materials used in TxDOT projects

Materials	Volume used or under contract	Expenditures (in millions)
Fly ash	1,586,278 tons	\$55.5
Crushed concrete	600,000 tons	7.2
Steel	286,328 tons	532.6
Crumb rubber	16,309 tons	65.1
Glass beads	14,250 tons	15.7
Reclaimed asphalt paving	1,246,043 cubic yards	0.0*
Compost	433,843 cubic yards**	0.5
		Total \$676.6

* TxDOT-owned material; no purchases necessary

** Amount was let and will be used over the next few years

Source: Texas Department of Transportation

concrete and wood go into another; cardboard is separated and baled. The biggest challenge is keeping the materials separated. If not, you end up paying us to double handle the materials. If you pick what you want to recycle and segregate it from everything else, then there is the potential for savings."



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Room to Grow

The typical construction project generates as much as 2.5 pounds of waste for every square foot of new floor space, according to the Associated General Contractors of America.

With the rapid rate of residential, commercial, and industrial building in Texas, there is great potential for recycling. Otherwise, the bulk of those materials ends up in a municipal landfill or a landfill designated for construction and demolition debris.

Diverting building materials from landfills not only helps municipalities with the responsibility of providing landfill space, but also lowers disposal expenses for road construction and building contractors.

The environment benefits, too. Large chunks of used concrete are commonly used in erosion control and shoreline protection, and recycling eases the demand on natural resources. Reclaiming steel, for example, saves on the amount of ore, coal, and limestone

required to make the new product.

Also, on-site recycling reduces the number of trucks making long hauls to the landfill—a factor that can help air quality.

Through research and testing, recycled products are now found in highways, bridges, guardrails, landscaping material, and signs. In some cases, the recycled materials actually improve the performance of the final product. For example, fly ash recovered from coal-burning power plants adds strength and durability to concrete, yet costs half of the cement it replaces. Whether providing a higher quality product or saving money, recycling has found a niche that appears secure and ready to grow.

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Reclaimed Materials

The United States generates high volumes of concrete, asphalt, and coal-combustion products. The Texas Department of Transportation has tapped into these sources and other materials that can be incorporated into highway infrastructure across the state. The recycling leaders are as follows:

Crushed concrete. Concrete from existing roadways, pavements, airfields, and buildings can be reused. After the material is crushed, magnets remove the steel rebar, and the remaining aggregate is screened to produce the desired consistency, ranging from coarse to fine. In the 1990s, the reconstruction of Houston's Interstate 10 (from Loop 610 to I-45) was the first project in the state in which all recycled aggregate was used for pavement concrete, according to TxDOT. Today, crushed concrete is used extensively in state projects in the Houston area and is fairly common in Dallas as well.

Reclaimed asphalt pavement. Interest in recycling hot-mix asphalt began when OPEC's oil embargo of the mid-1970s sent construction costs soaring. Since then, contractors have proved that hot-mix asphalt can be recycled on roadways multiple times. In fact, recycled pavement has been shown to have the same durability as pavements built with virgin materials. The material has widespread use in construction and maintenance, such as roadbase aggregate and shoulder surfacing and widening.

Reclaimed metals. Almost all metals contain some recycled content. Steel and aluminum are common in road construction—both are highly reusable and recyclable. Salvaged from automobiles, appliances, and construction materials, steel is vital to bridge building and repairs, and reusing aluminum signs is cheaper than buying new ones. Also, state roadways contain recycled-content metals in concrete reinforcing bars (rebar), guardrails, sign posts, and manhole covers.

Coal-combustion products. Byproducts such as fly ash and bottom ash are residuals from burning coal to produce electricity. Fly ash is used in highway construction, primarily in concrete and roadbase. Bottom ash is used by TxDOT for de-icing and in roadbase.



In this milling machine, steel teeth grind asphalt off the road surface. The material is recycled on site and reapplied as hot-mix asphalt to the surface./Photo by the Texas Department of Transportation

Glass. Many municipal recycling programs produce large quantities of waste glass that can be crushed to produce uniform-sized glass cullet. Highway builders incorporate the cullet into roadbase or use it as bedding material around culverts or pipes. Reflective glass beads, made mostly from plate glass, end up in highway striping and reflective signs.

Tires and crumb rubber. Finely ground rubber from scrap tires has found its way into asphalt paving, crack sealer, and molded-rubber products. The availability of crumb rubber in Texas is increasing with the opening of new production facilities. TxDOT also is testing the use of tire bales to build and stabilize embankments.

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